More Efficient, More Powerful RTGs for Planetary Science Missions

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Radioisotope Thermoelectric Generators – RTGs

US Department of Energy has produced a variety of RTGs that have been flown over the last 50 years by NASA.

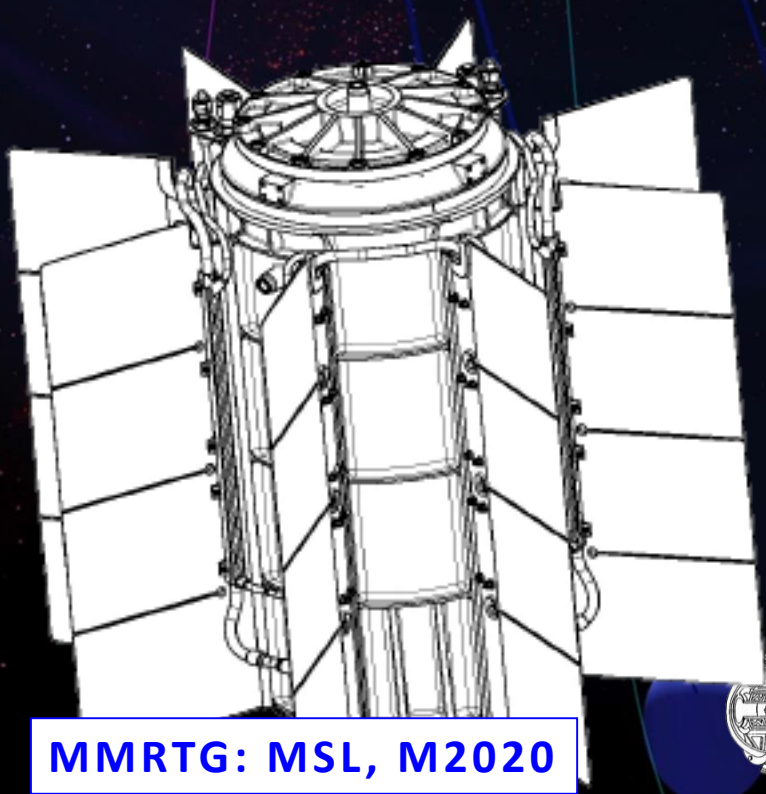
Convert heat produced from the natural decay of plutonium dioxide into quiet DC power.

- Long-lived – decades in flight
- Reliable – no failures

Voyager spacecraft have been powered by RTGs for 40 years

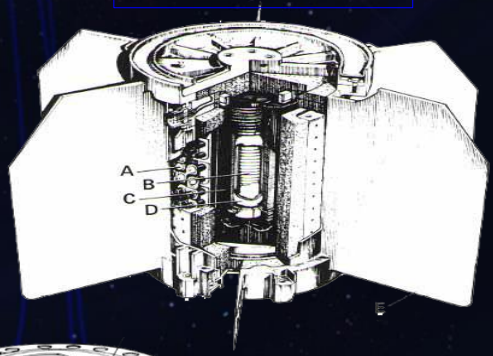
Only the MMRTG can be procured today

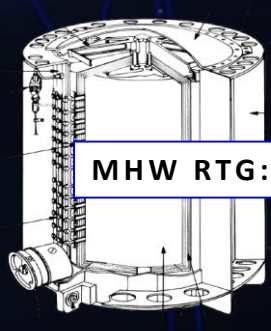
Future NASA science missions could benefit from an alternative RTG design



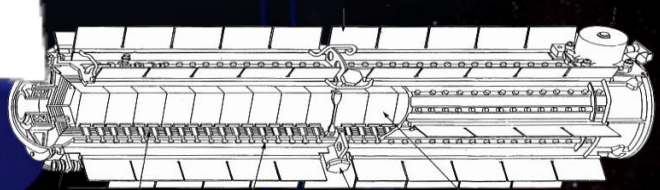
MMRTG: MSL, M2020

SNAP-27 RTG: Pioneer, Viking





MHW RTG: Voyager



GPHS RTG: Ulysses, Galileo, Cassini

Pre-Decisional – For Planning Purposes Only

Planning for The Future of Planetary Exploration

At this time, NASA is developing technology for an upgrade of the MMRTG, the RTG being used by MSL on Mars. The potential upgrade is called the *eMMRTG*.

The *enhanced* Multi-Mission Radioisotope Thermoelectric Generator would:

- Retrofit MMRTG with more efficient thermoelectric couples
- Midway through Technology Maturation Phase with industry
- Objective is increase the power at the *end* of the RTG's Design Life by 50% or more

In addition, the planetary science community identified a need for more efficient and powerful RTGs for future missions. NASA funded a study to identify Next-Generation RTG concepts.

Specifically, determine the characteristics of a Next-Generation RTG that would "best" fulfill Planetary Science Division's mission needs.

- An RTG that would be useful across the solar system
- An RTG that maximizes the types of potential missions: flyby, orbiter, lander, rover, boats, submersibles, balloons
- An RTG that has reasonable development risks and timeline
- An RTG that has a value (importance, worth and usefulness) returned to PSD that warrants the investment as compared with retaining existing baseline systems

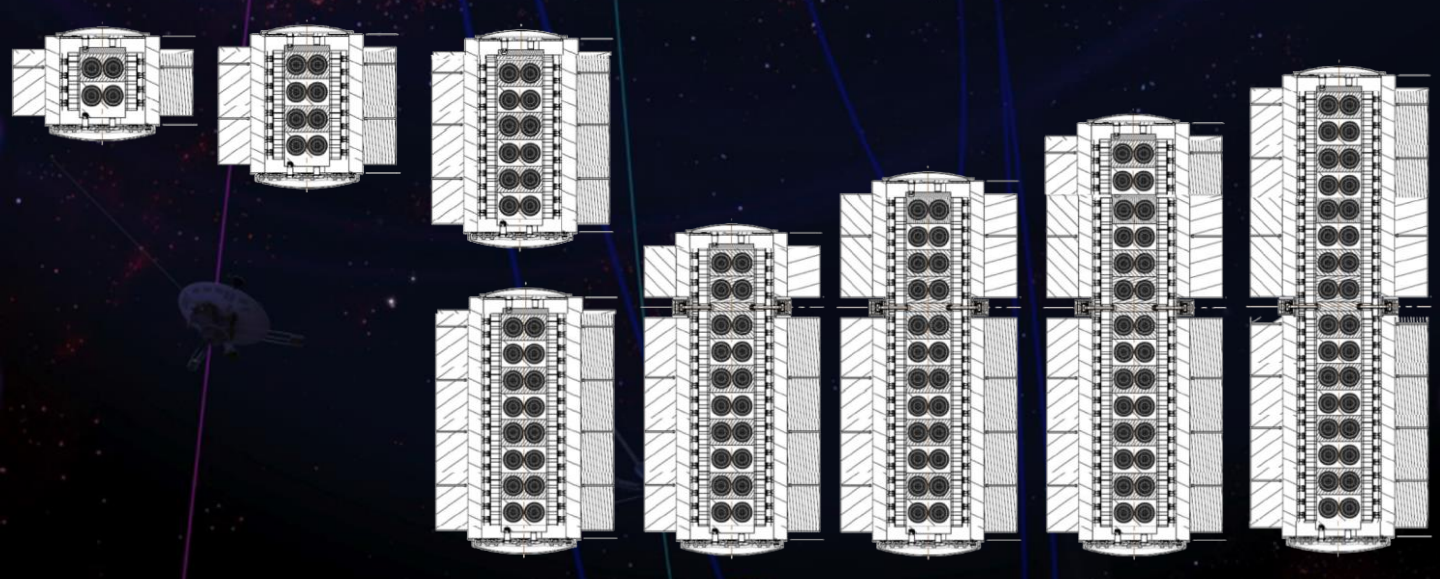
NEXT-GEN RTG STUDY*: OVERVIEW OF RECOMMENDATIONS

Complete eMMRTG

- Continue with skutterudite thermoelectric couple (TC)
- Carry development to eMMRTG Qualification Unit

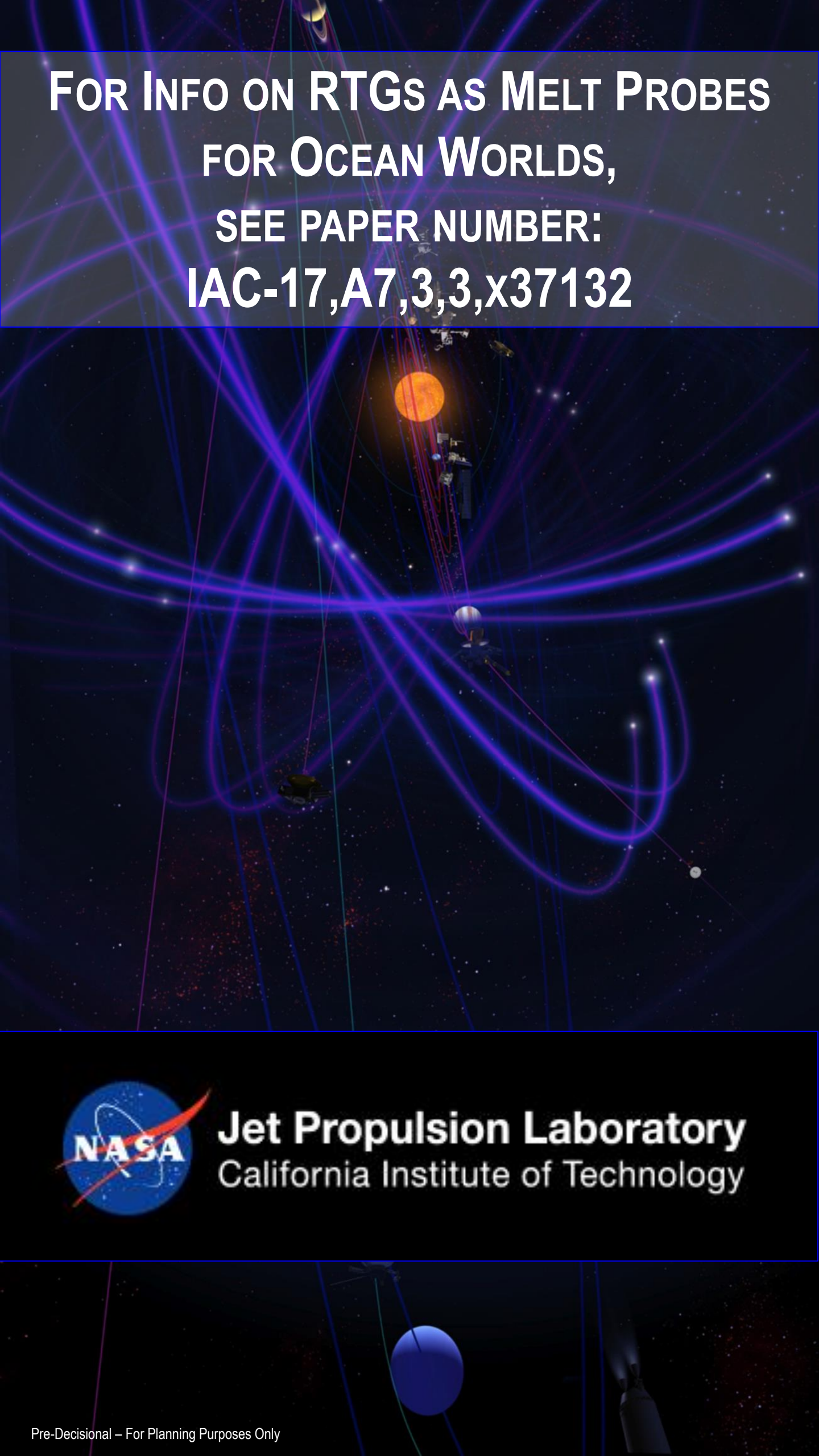
Initiate Next-Generation RTG Concept refinement in FY18

- Vacuum-only
- Modular
- 16 GPHSs (largest RTG variant)
- P_{BOM} = 400-500 We (largest RTG variant)
- Mass goal of < 60 kg (largest RTG variant)
- Degradation rate < 1.9 %
- System to be designed to be upgraded with new TCs as technology matures
- Conceptual Next-Generation RTGs *
  - Modular: 50 – 500 W (Beginning Of Life)
    20 – 60 kg
  - Efficient: 10-15%
  - Copious waste heat: 450 – 3500 Wth
  - Within reach, could be available by 2028



Artist concepts from:

* Woerner, et al, *Next-Generation Radioisotope Thermoelectric Generator Study Final Report,* June, 2017, JPL-internal Document: JPL D-99657



For Info on RTGs as Melt Probes for Ocean Worlds, see paper number: IAC-17,A7,3,3,x37132

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